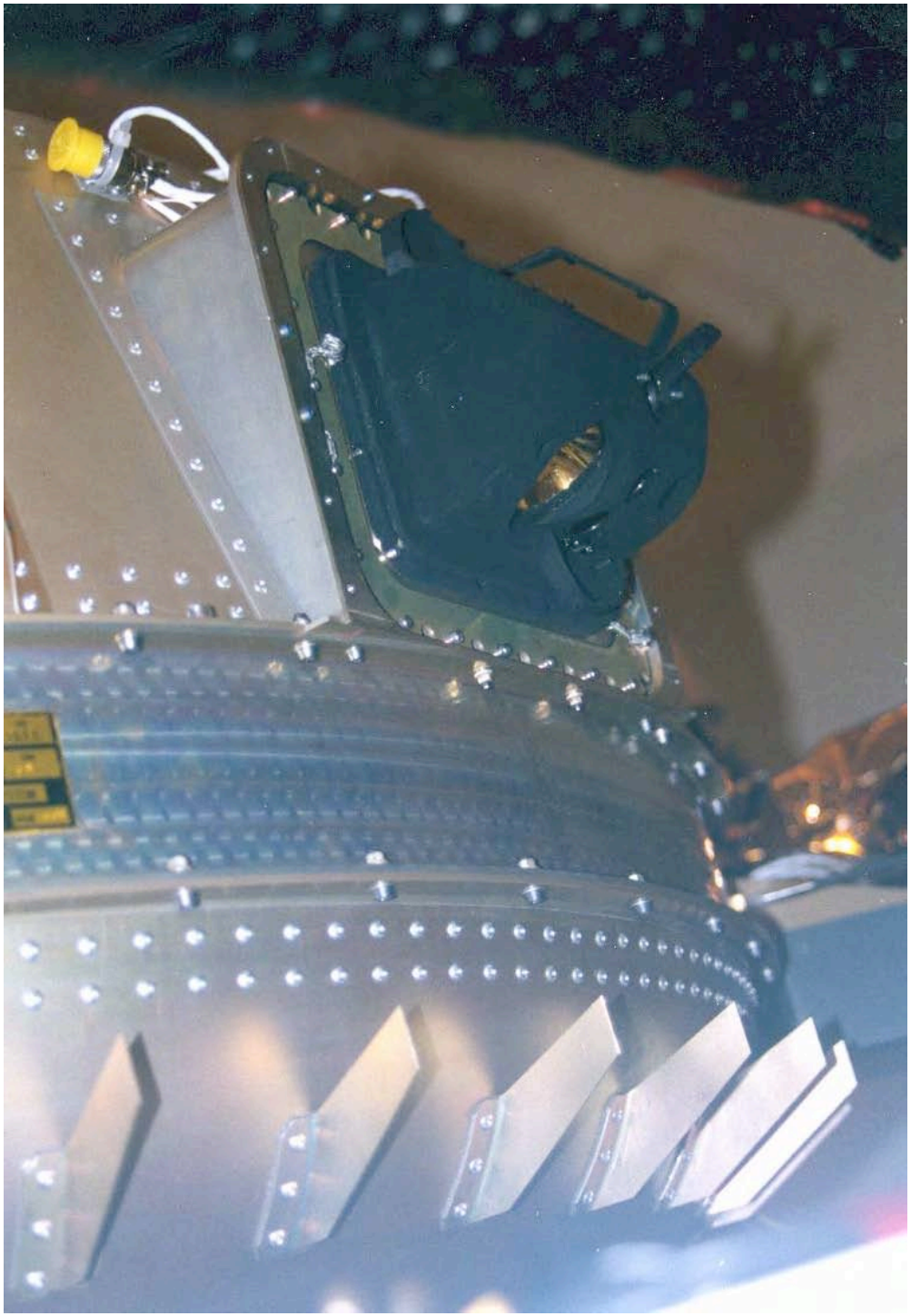
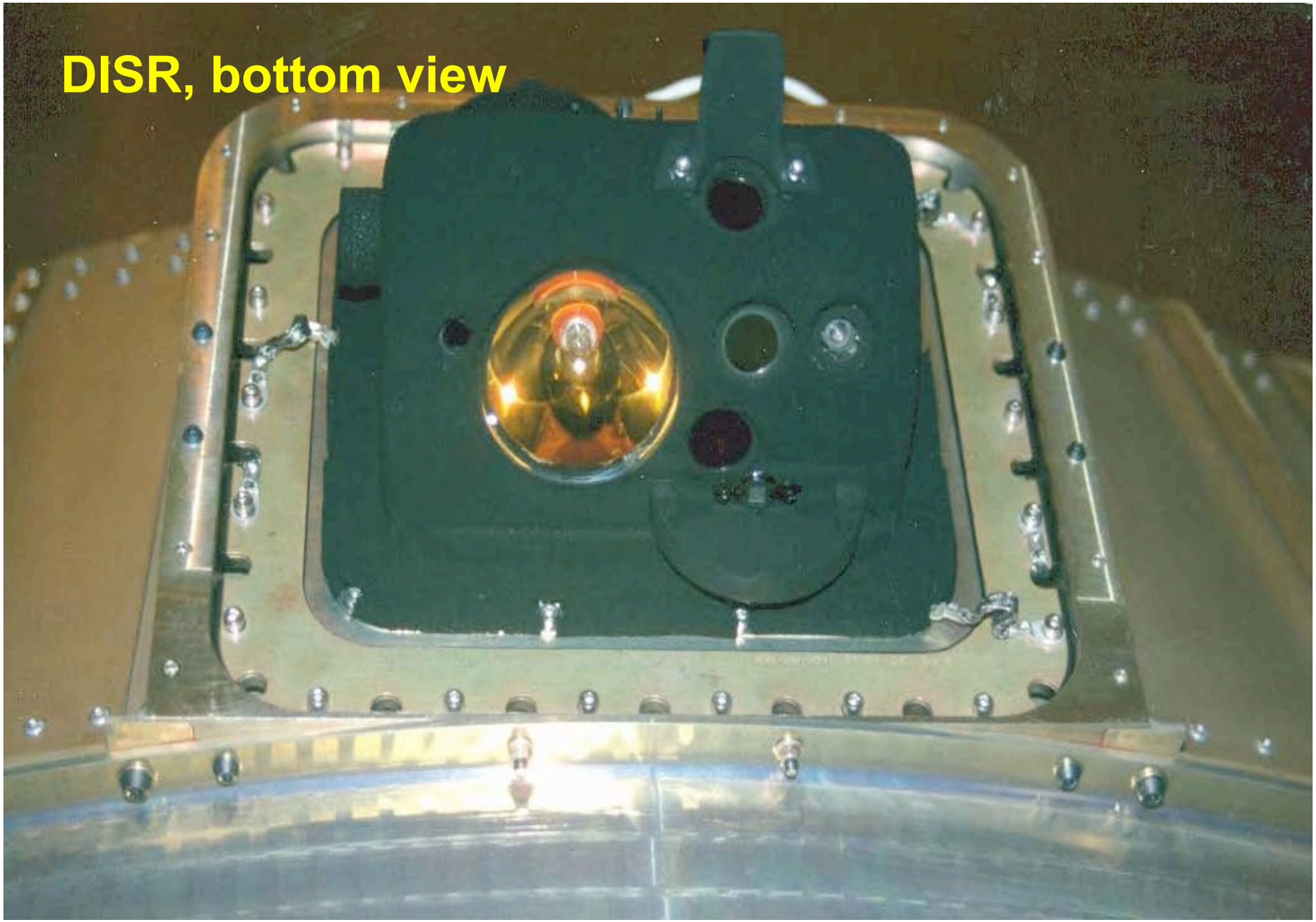


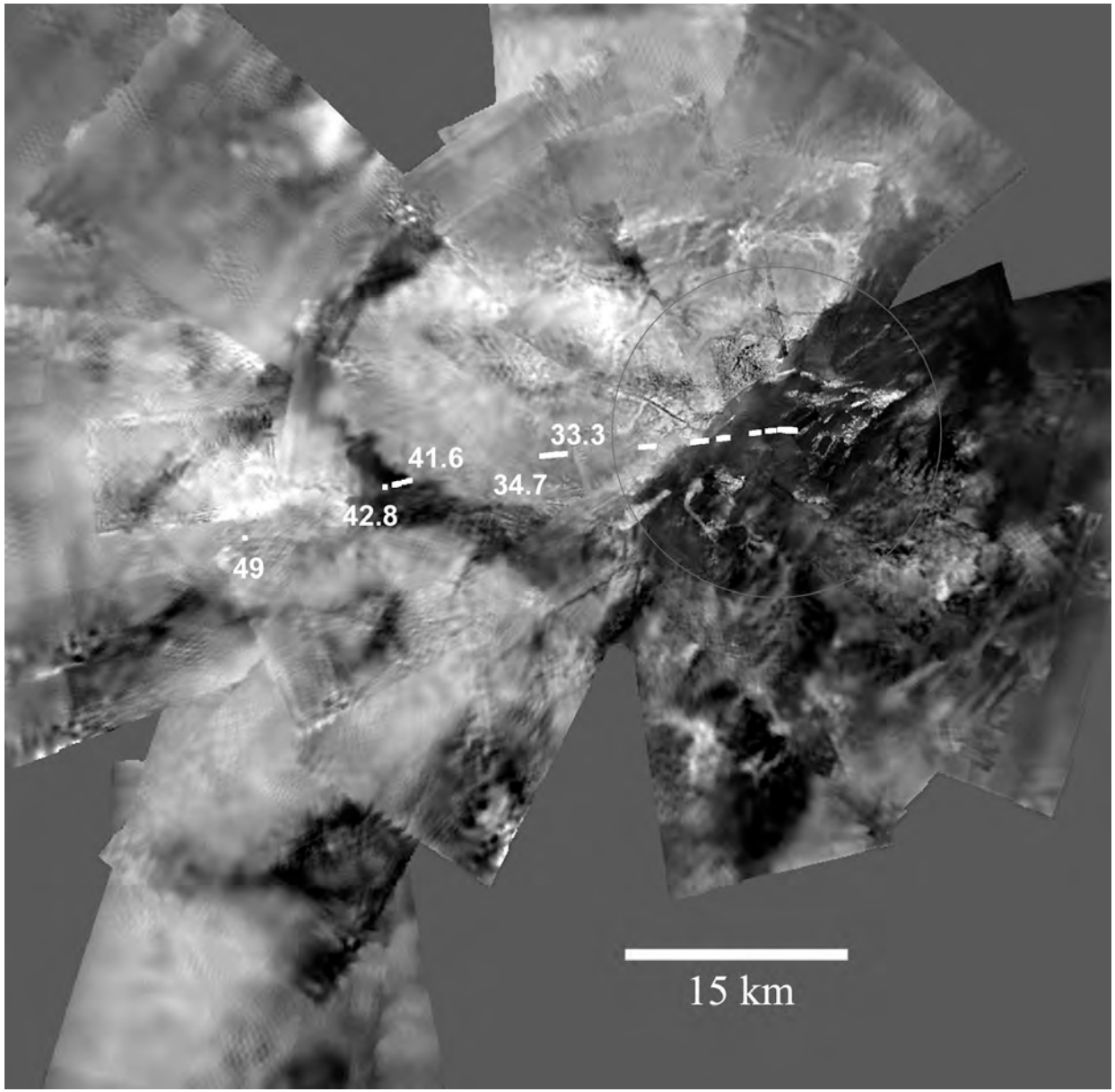
DISR, Descent Imager / Spectral Radiometer Right side

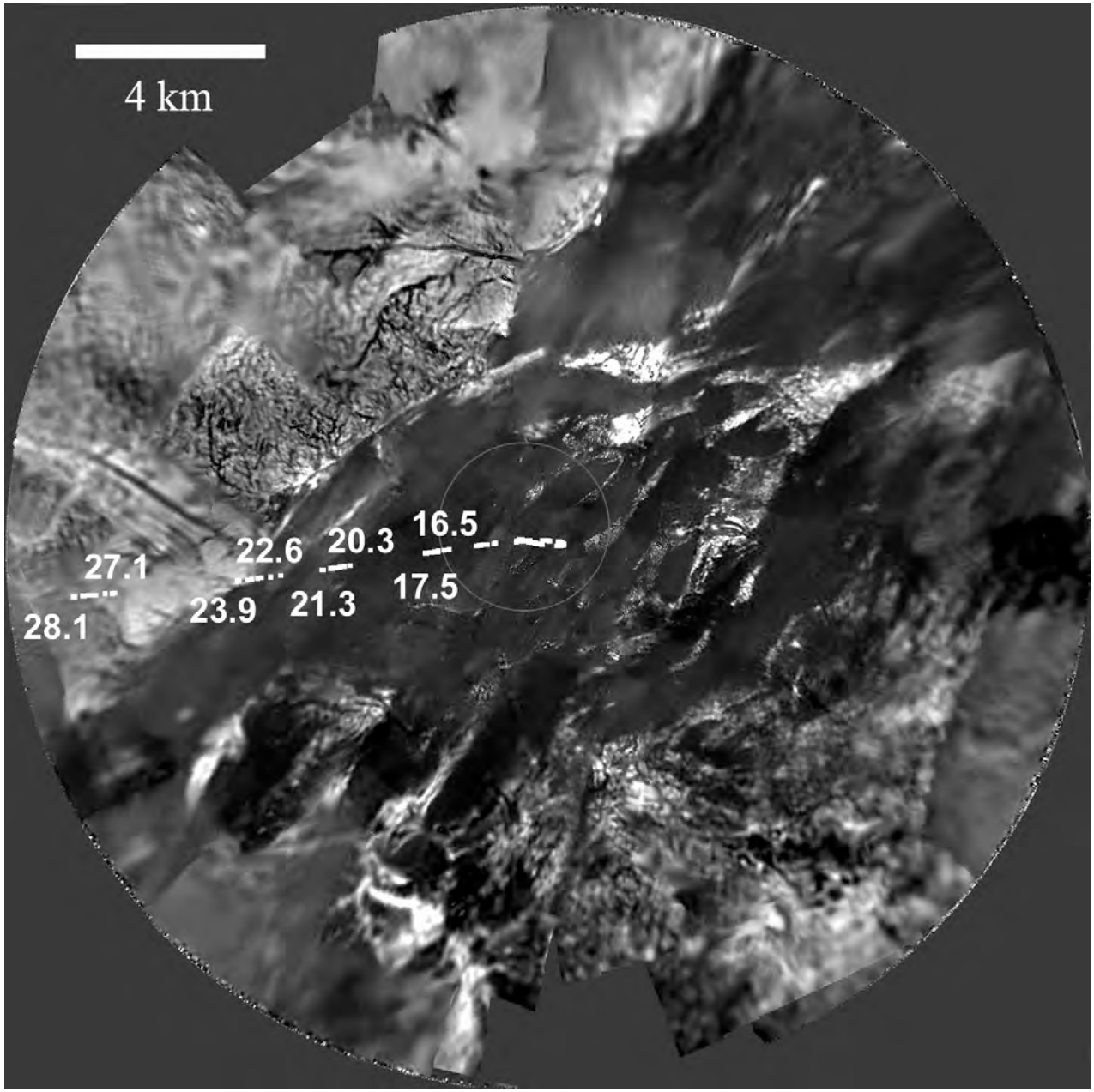

DISR, bottom view

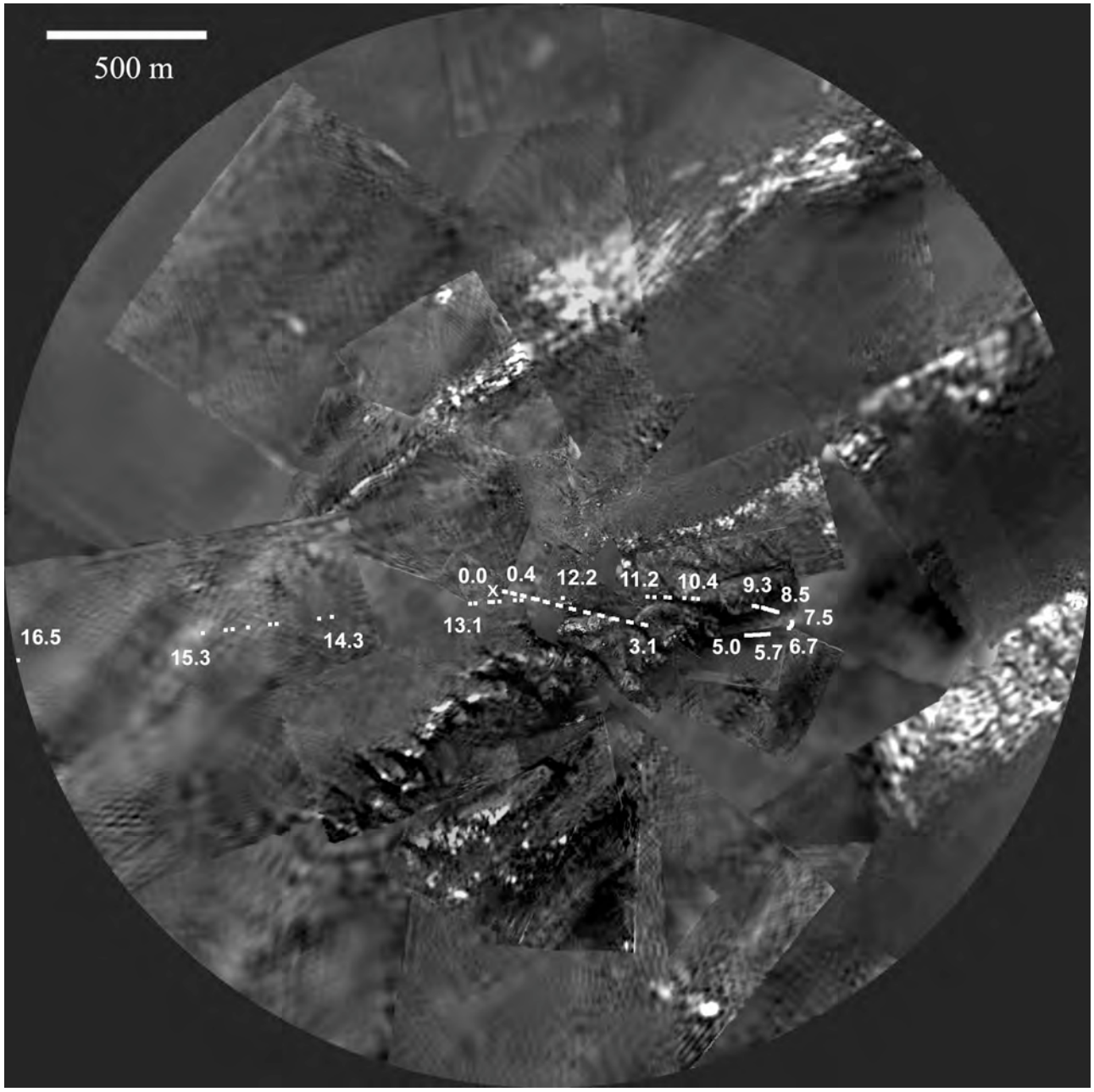
A. IDL*-based Mosaic and Control Point Creator

1. Interactive (manual) manipulation of (partial) image triplets
2. Drag-and-drop & swivel system
3. Sub-probe Longitude & Latitude, Ground Azimuth, Roll & Pitch and Altitude values can be changed or locked (values frozen)
4. Several projections available (gnomonic, mercator, stereographic, conic), but for Huygens data, gnomonic is most useful, plus mercator at less than 3 km altitude
5. Control Points measured from native single image frames (not from projected triplets)
6. Mosaic creation and position & attitude determination requires isolating a degree of freedom and mapping it to a simple movement in one of the available projections
7. lack of horizon visibility above 3 km closed off two of the most straightforward mappings: roll and pitch.
8. Sky brightness variation can be used (subject of the paper given in IPPW1) but sky brightness model not available yet

*IDL = Interactive Data Language

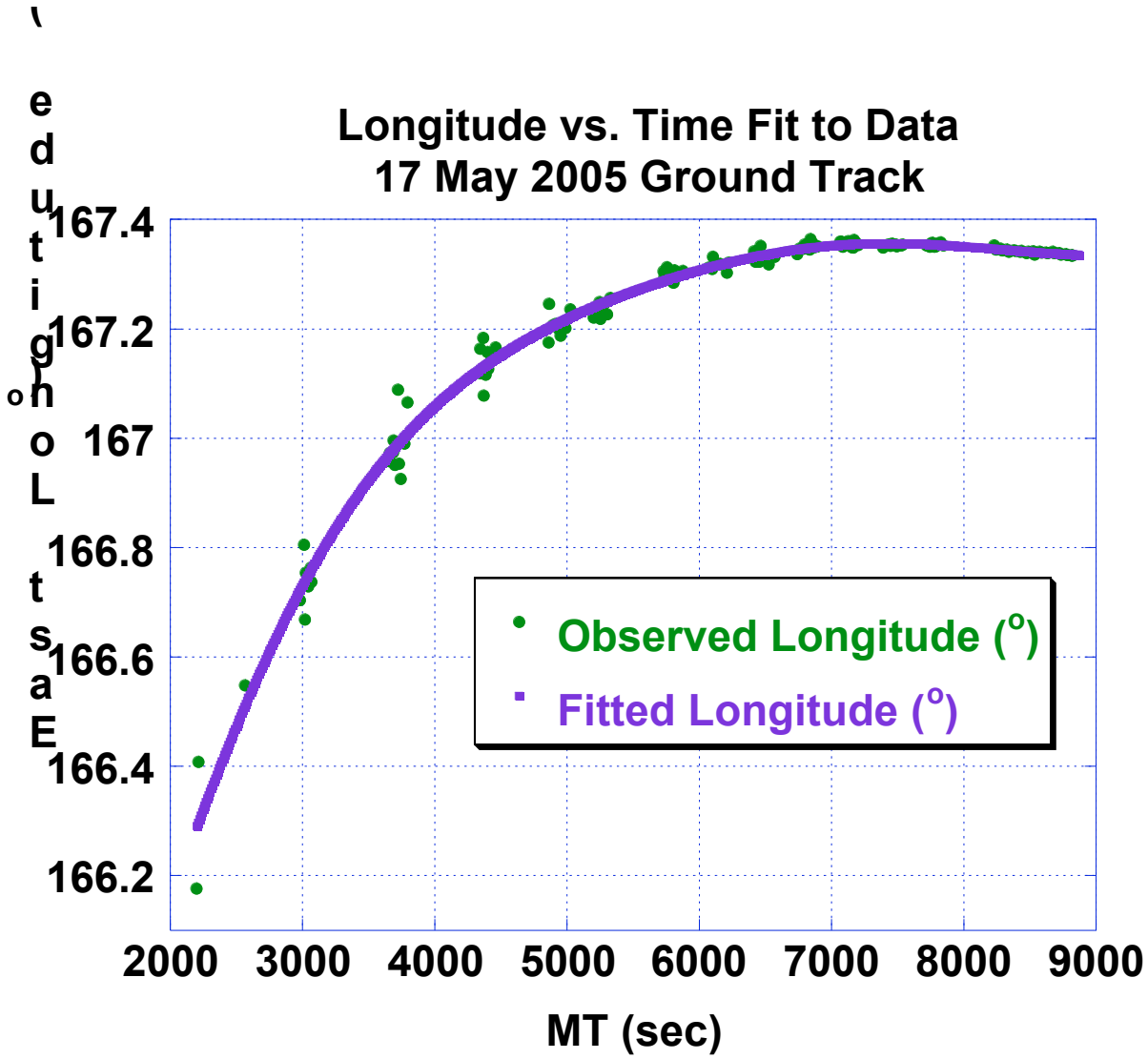

33.3
41.6
34.7
42.8
49
15 km

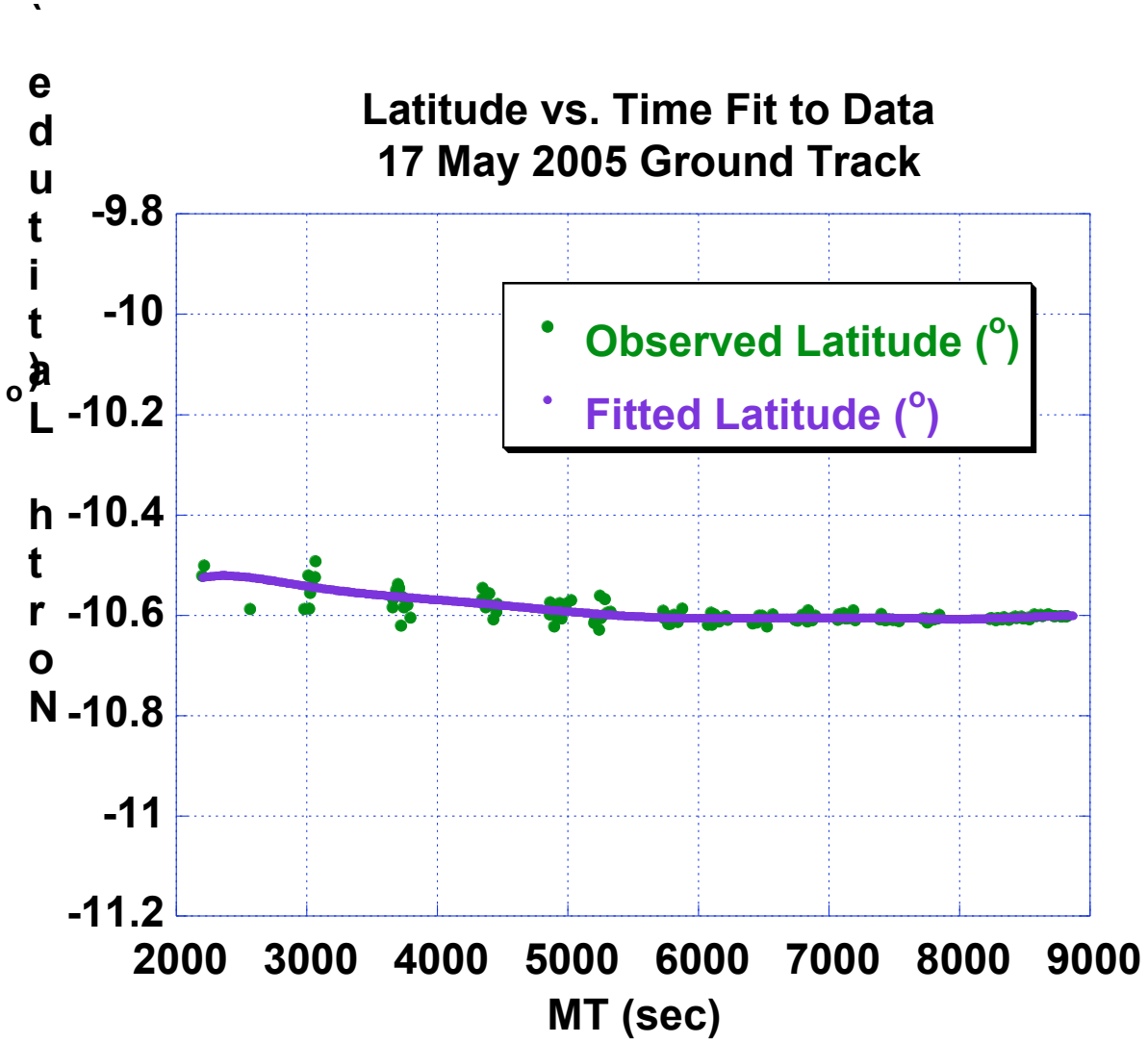

4 km
27.1
28.1
22.6
23.9
20.3
21.3
16.5
17.5

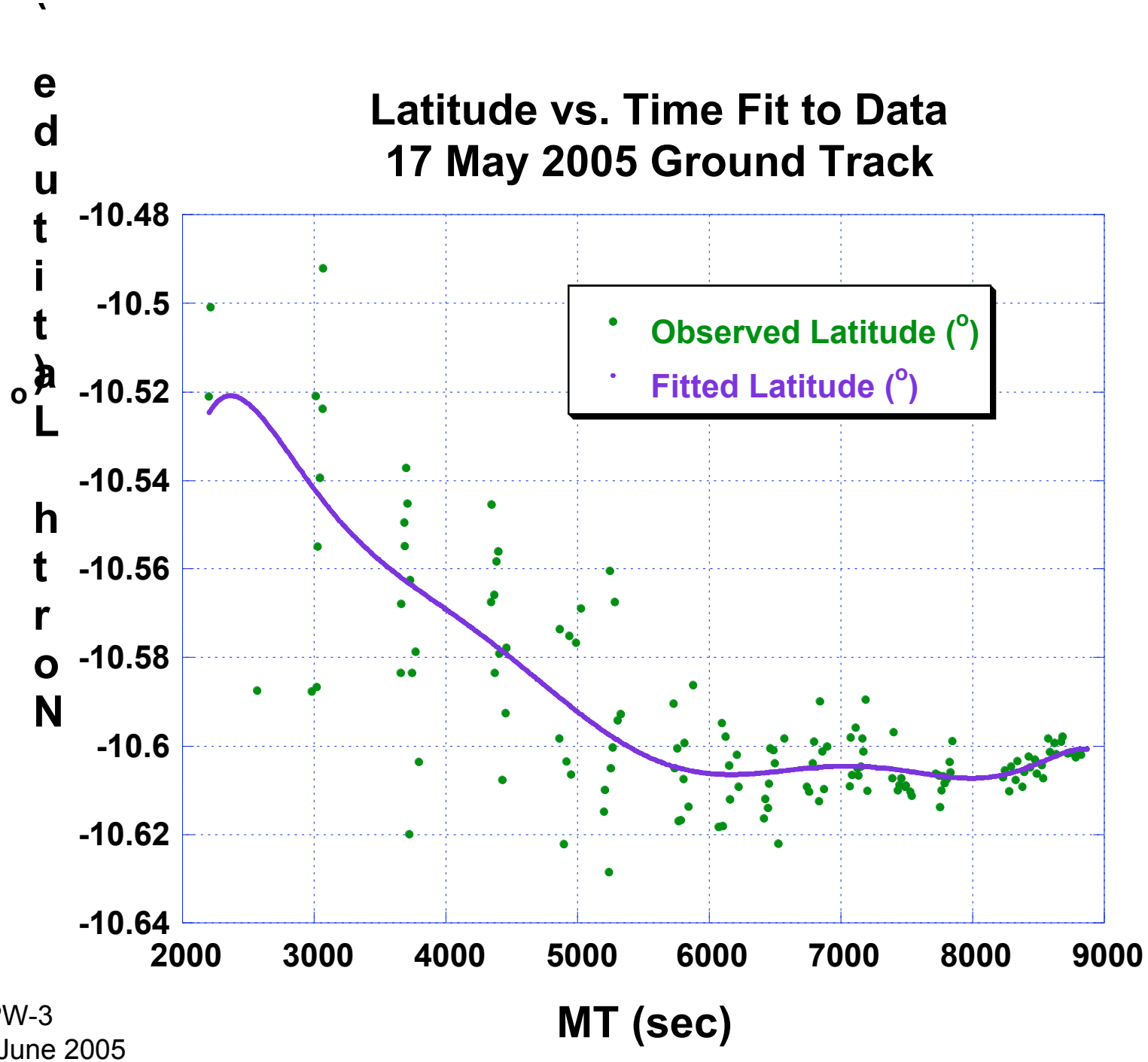

500 m
0.0
0.4
12.2
11.2
10.4
9.3
8.5
7.5
6.7
5.7
5.0
3.1
13.1
14.3
15.3
16.5

B. Latest Sub-Probe Longitude/Latitude/Azimuth Measurements

1. 20^{o} disagreement between azimuth scale derived from Sun Sensor at high altitudes (37-55 km) and near-surface Upward-Looking Infrared Spectrometer data motivated latest round of mosaic construction (error in ULIS surface data is 8%)
2. Disagreement still exists; data averaged into a unified azimuth model
3. Two images identified at highest altitude yet (55.1 km); more images identified at 34 and 41 km; azimuths predicted nicely by existing (SS-derived) azimuth model
4. Chains of image-pair overlaps from highest to lowest altitudes generally number about 10-12; minimizing number while maintaining significant feature overlap improves azimuth scale transfer to near-surface images
5. To believe ULIS data requires assuming a slowdown in rotation rate in the last 10-20 seconds
6. DTWG Interface Offsets in Lng/Lat = 166.5991^{o} E, -10.34^{o}
7. DWE Interface Offsets in Lng/Lat = 166.6120^{o} E, -10.3284^{o}

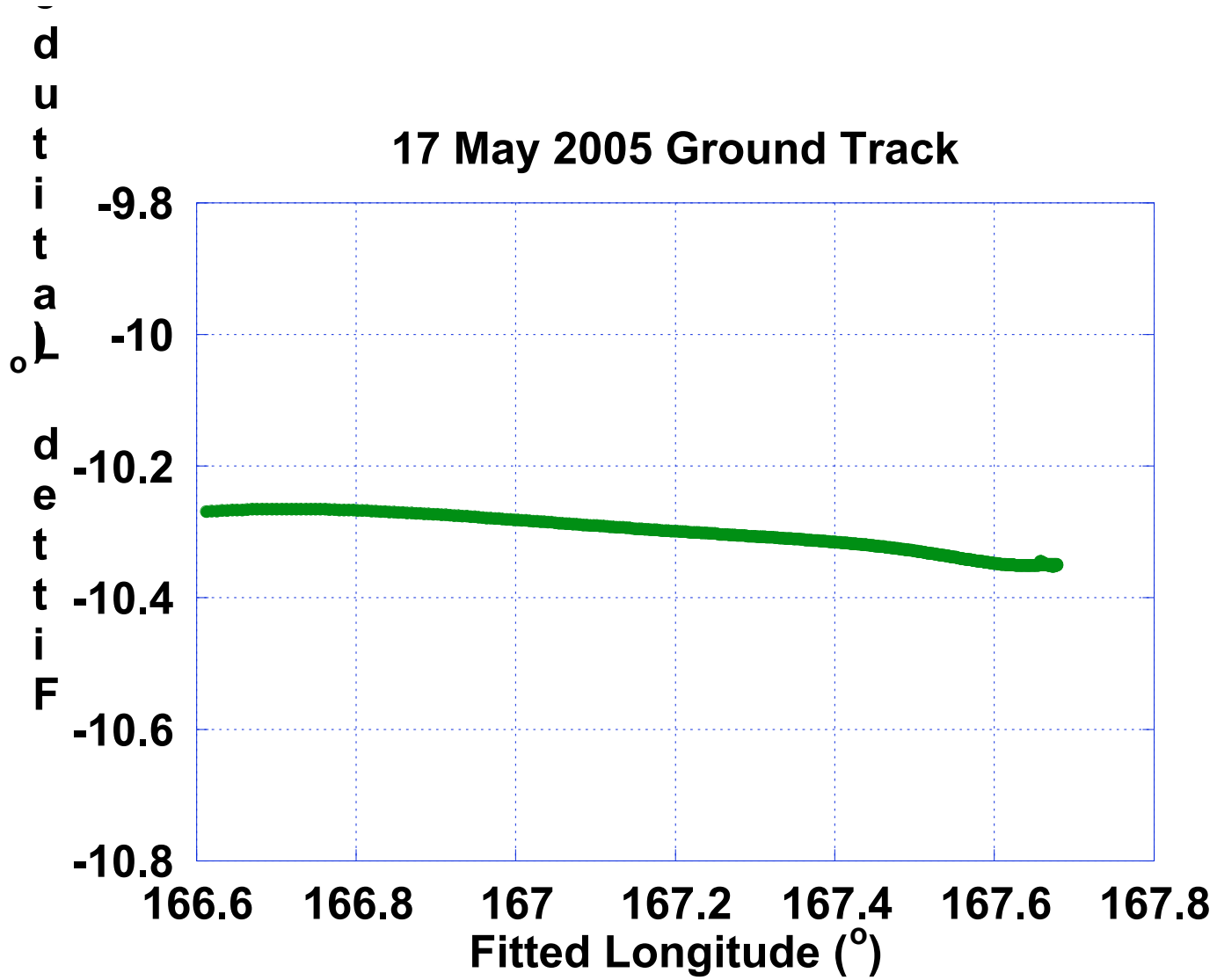

Longitude vs. Time Fit to Data
17 May 2005 Ground Track
East Longitude (°)
167.4
167.2
167
166.8
166.6
166.4
166.2
2000
3000
4000
5000
6000
7000
8000
9000
MT (sec)
Observed Longitude (°)
Fitted Longitude (°)


Latitude vs. Time Fit to Data
17 May 2005 Ground Track
Observed Latitude (°)
Fitted Latitude (°)
-9.8
-10
-10.2
-10.4
-10.6
-10.8
-11
-11.2
2000
3000
4000
5000
6000
7000
8000
9000
MT (sec)


Latitude vs. Time Fit to Data
17 May 2005 Ground Track
Observed Latitude (°)
Fitted Latitude (°)
-10.48
-10.5
-10.52
-10.54
-10.56
-10.58
-10.6
-10.62
-10.64
2000
3000
4000
5000
6000
7000
8000
9000
MT (sec)

C. Longitude and Latitude Fits

1. Fits constructed by averaging image data cycle by cycle (about 15 cycles)
2. Latitude Fit has problems near high altitude, as well as near surface
3. Ground Track Constructed on best-guess absolute longitude-latitude scale and then adjusted to either DTWG-3 or DWE reconstruction high-altitude longitude and latitudes (Time after T0, mission time, of 2200 sec (55 km))


17 May 2005 Ground Track
-9.8
-10
-10.2
-10.4
-10.6
-10.8
166.6
166.8
167
167.2
167.4
167.6
167.8
Fitted Longitude (°)

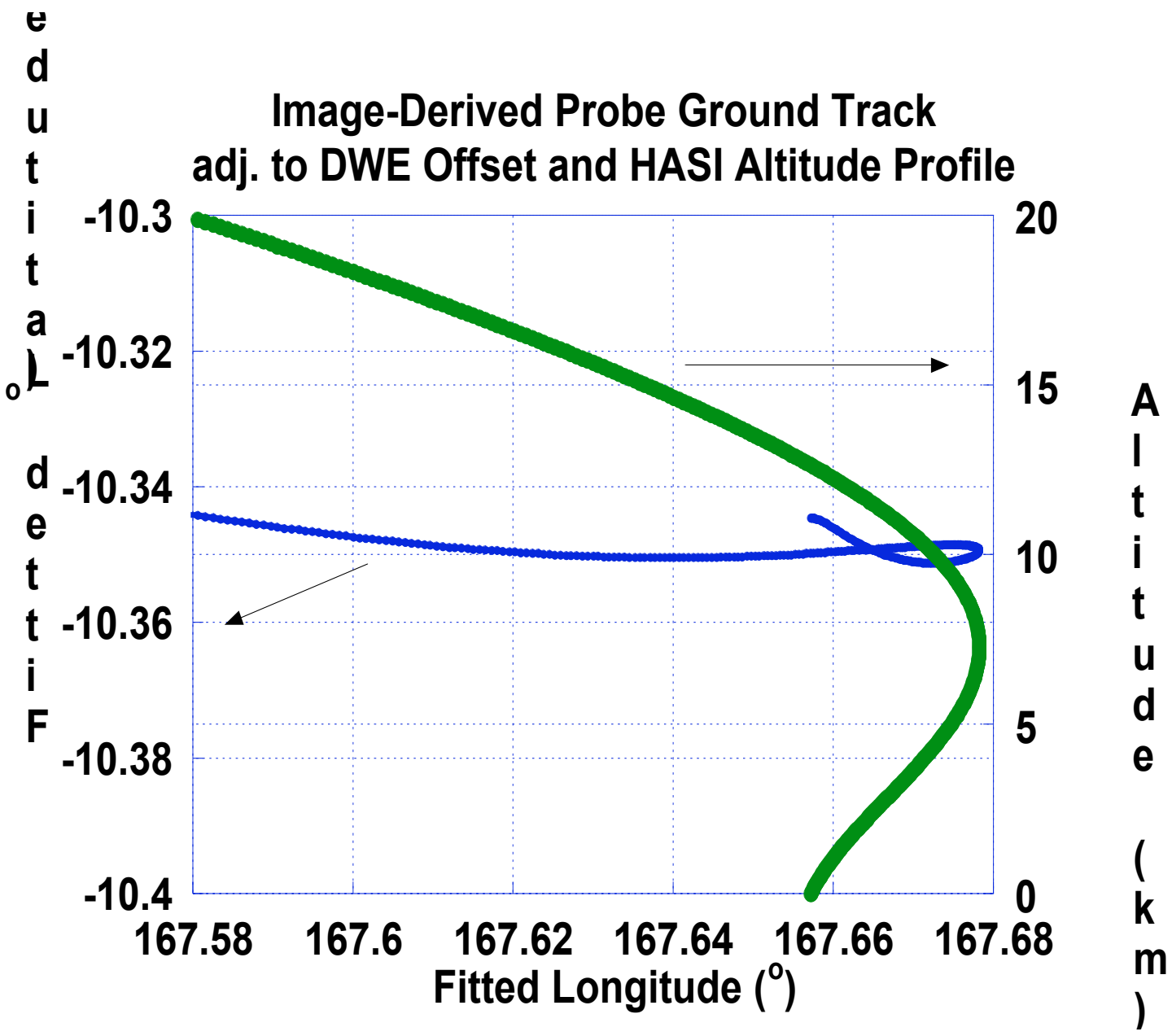
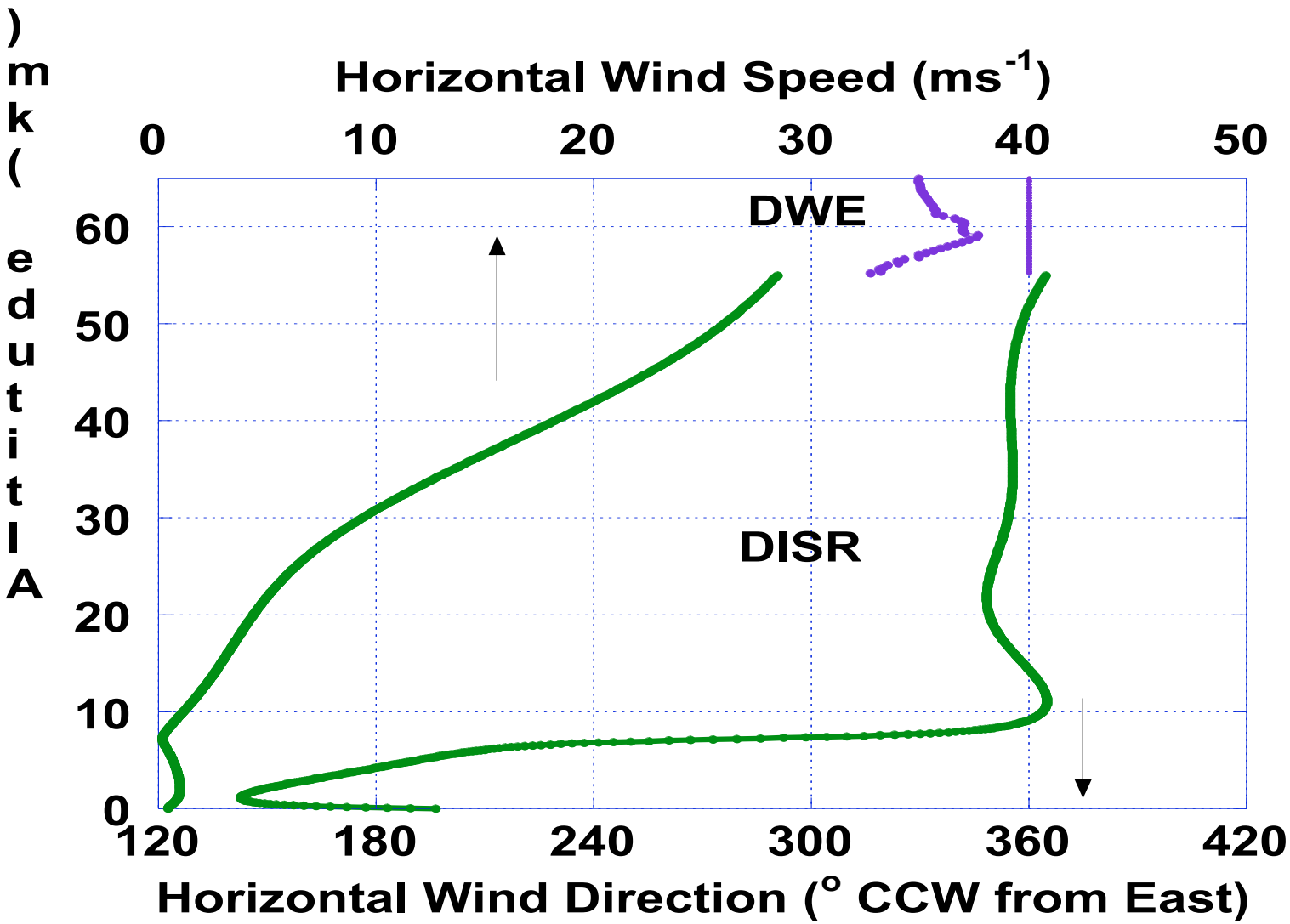
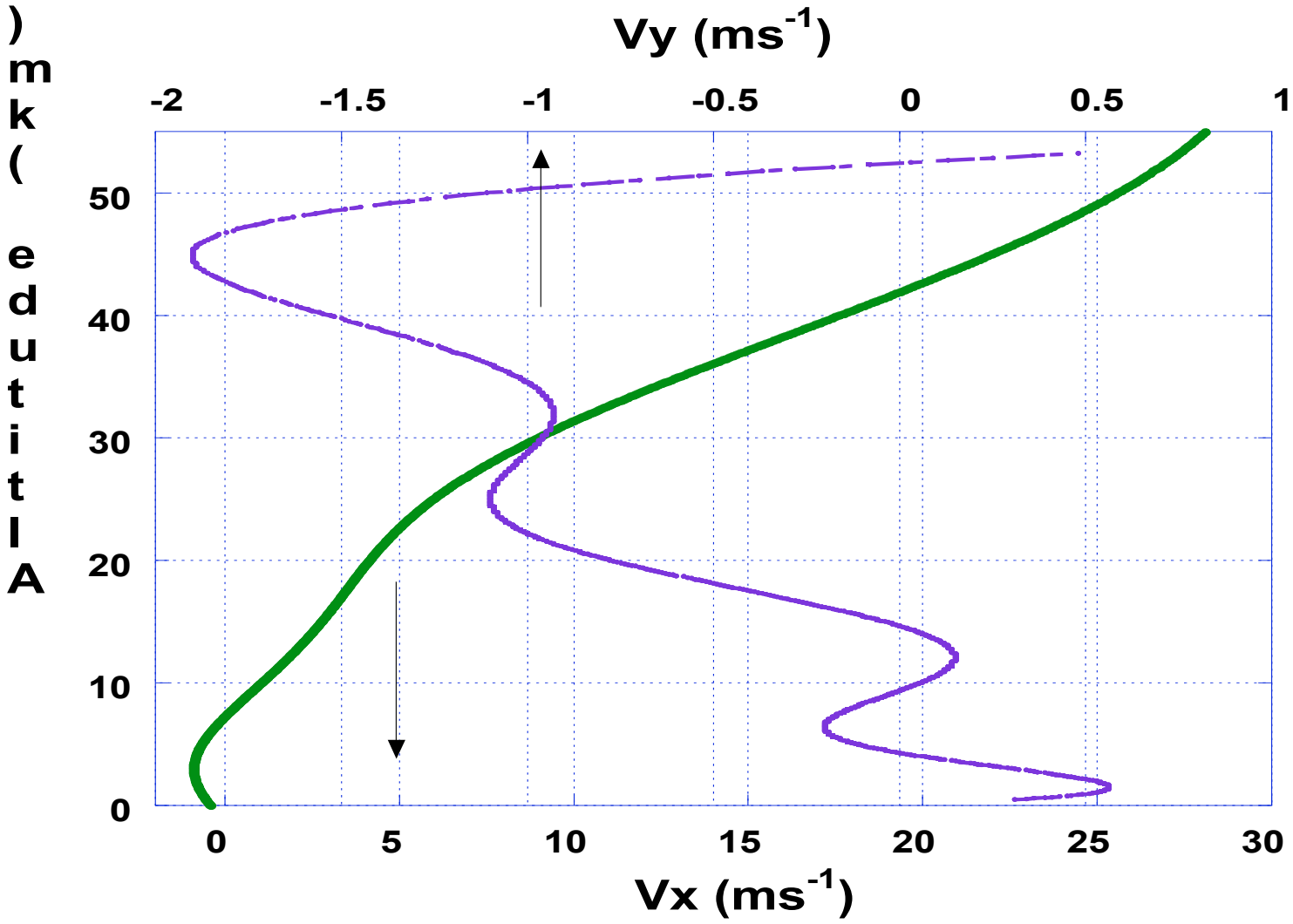
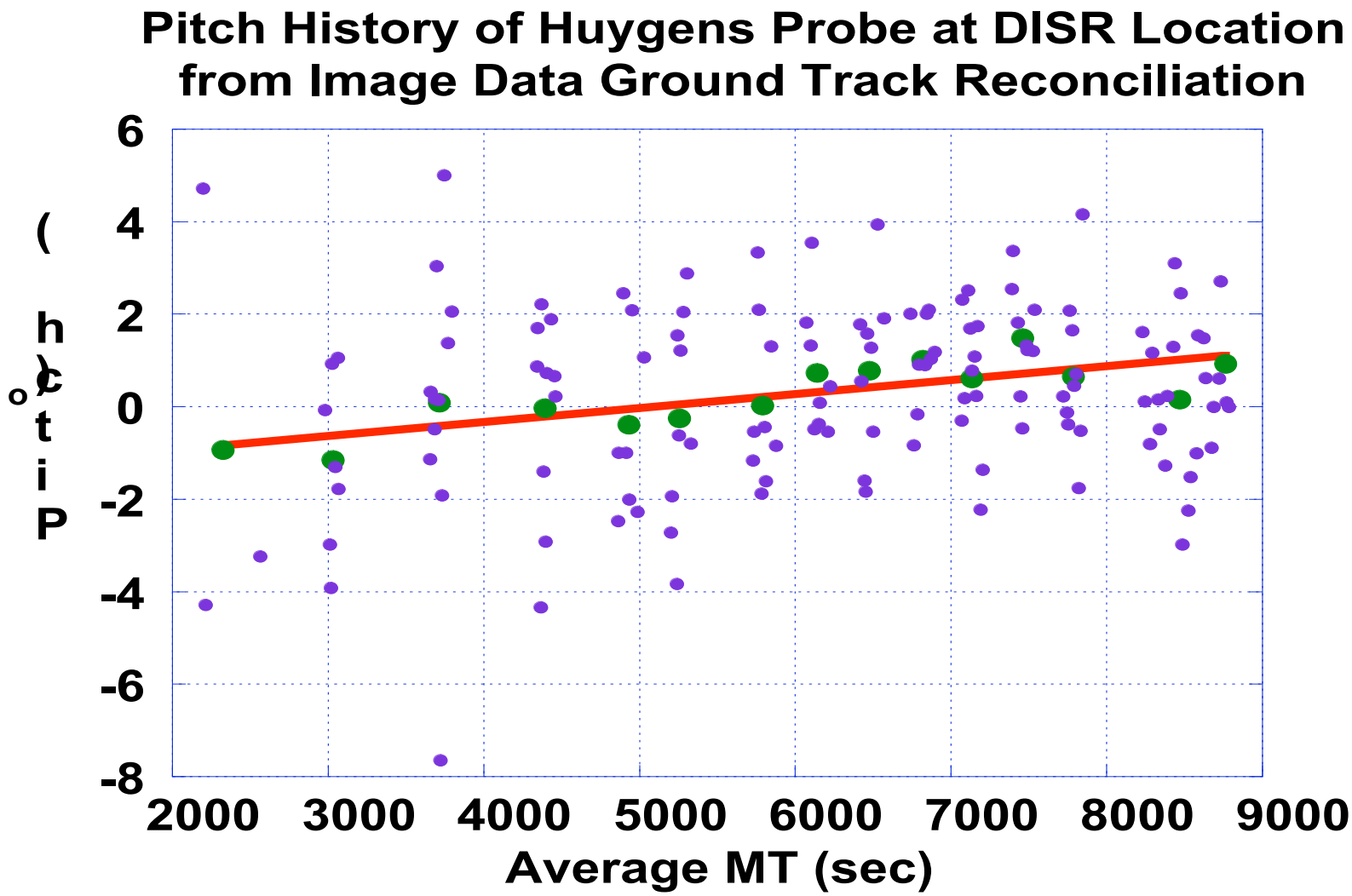
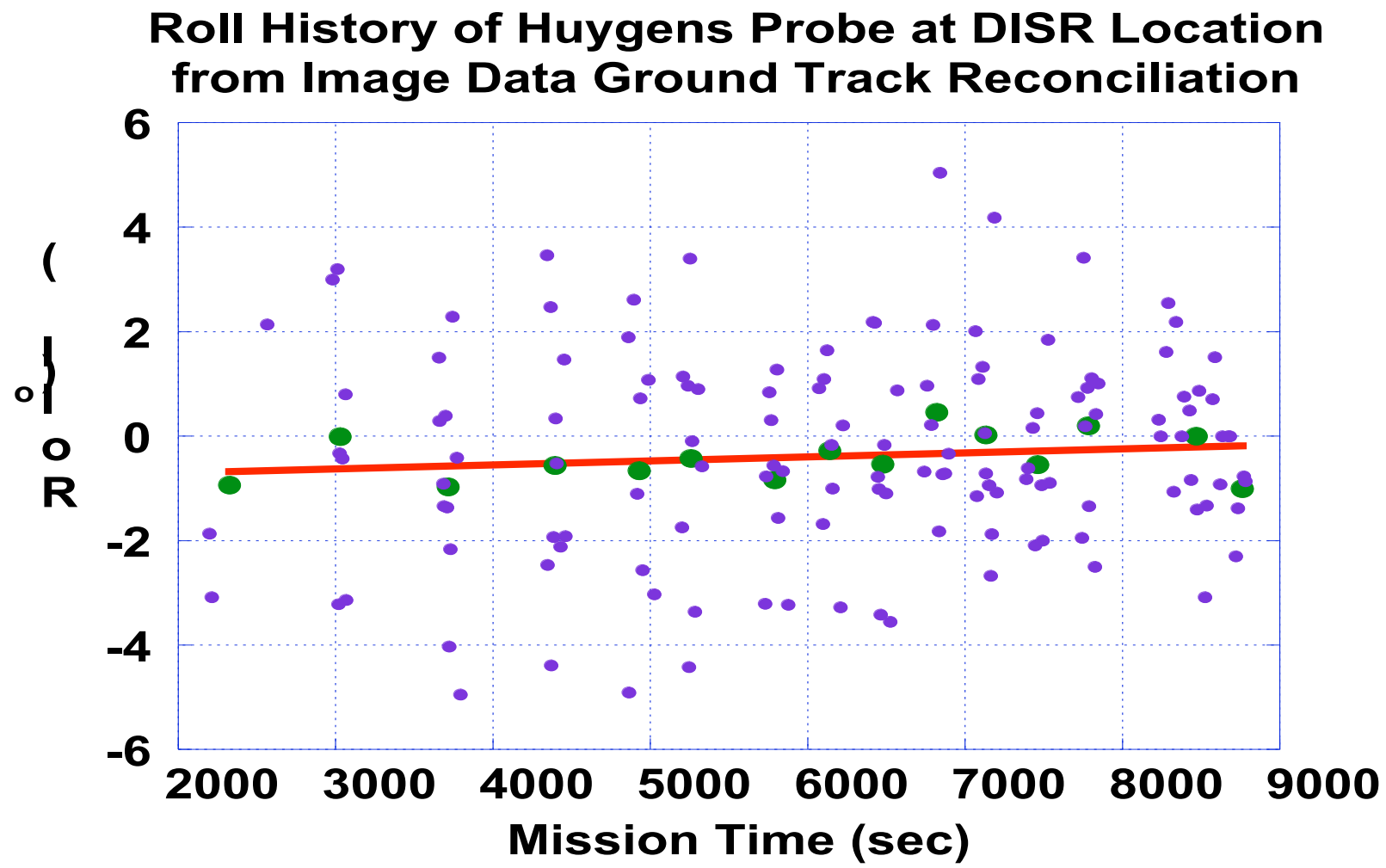


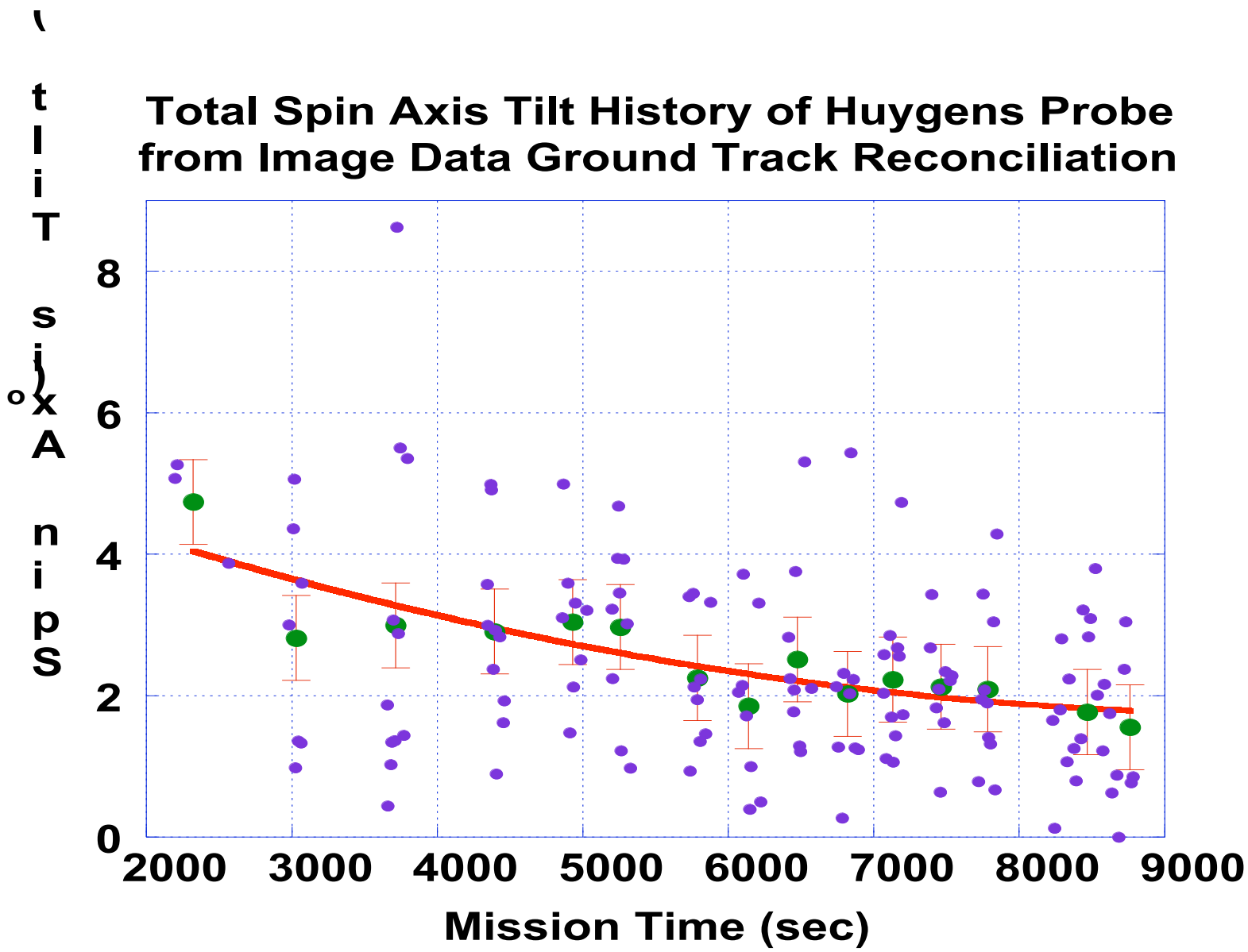
Image-Derived Probe Ground Track
adj. to DWE Offset and HASI Altitude Profile
Latitude (°)
-10.3
-10.32
-10.34
-10.36
-10.38
-10.4
20
15
10
5
0
Altitude (km)
167.58
167.6
167.62
167.64
167.66
167.68
Fitted Longitude (°)

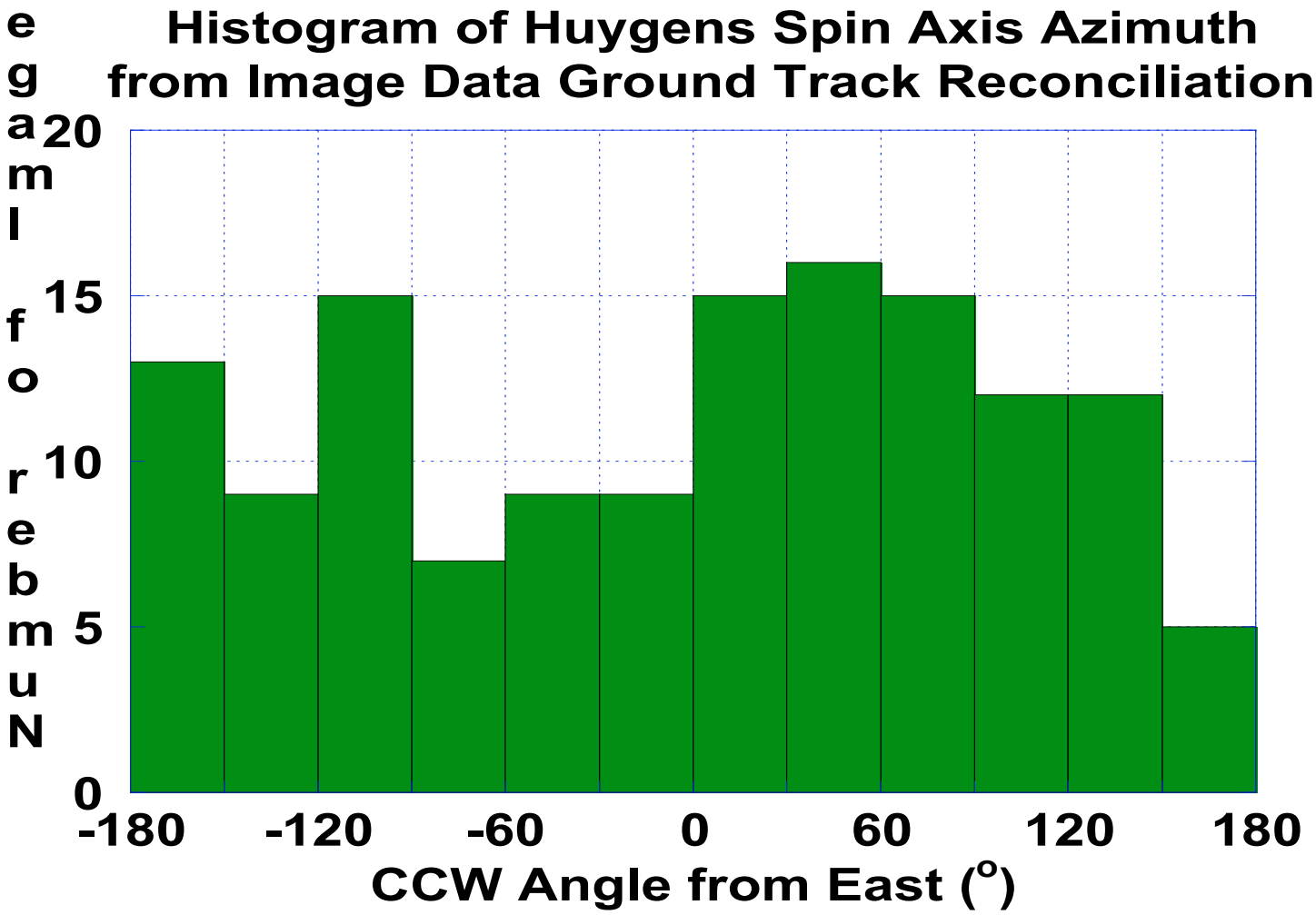

Horizontal Wind Speed (ms-1)
0
10
20
30
40
50
DWE
DISR
60
50
40
30
20
10
0
120
180
240
300
360
420
Horizontal Wind Direction (° CCW from East)


Vy (ms-1)
-2
-1.5
-1
-0.5
0
0.5
1
50
40
30
20
10
0
0
5
10
15
20
25
30
Vx (ms-1)


Pitch History of Huygens Probe at DISR Location
from Image Data Ground Track Reconciliation
Pitch (deg)
6
4
2
0
-2
-4
-6
-8
2000
3000
4000
5000
6000
7000
8000
9000
Average MT (sec)

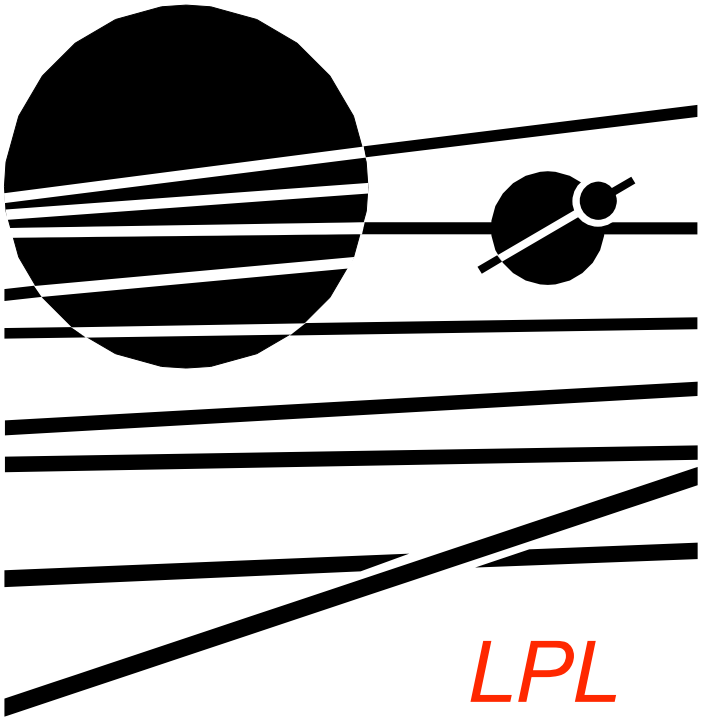

Roll History of Huygens Probe at DISR Location
from Image Data Ground Track Reconciliation
6
4
2
0
-2
-4
-6
2000
3000
4000
5000
6000
7000
8000
9000
Mission Time (sec)

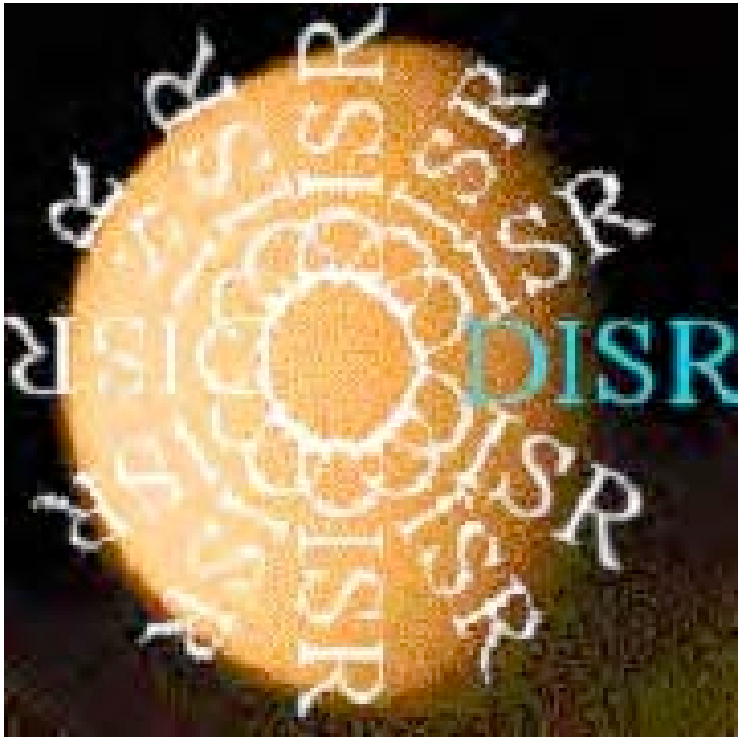

Total Spin Axis Tilt History of Huygens Probe
from Image Data Ground Track Reconciliation
Spin Axis Tilt (°)
0
2
4
6
8
2000
3000
4000
5000
6000
7000
8000
9000
Mission Time (sec)


Histogram of Huygens Spin Axis Azimuth
from Image Data Ground Track Reconciliation
Number of Images
0
5
10
15
20
-180
-120
-60
0
60
120
180
CCW Angle from East (°)

D. Tilt (Attitude) History

1. Roll and Pitch Histories should average to zero because our longitude and latitude history fits are predicated on that assumption
2. Total Tilt History shows factor of 2 decrease between 50 km and near-surface; nominally agrees with predicted factor of 2 decrease in wind shear predicted before the mission by Strobel and Sicardy
3. Individual Cycles Show Some Secular Movement, but with significant aliasing, i.e., often difficult to confidently identify a periodicity in the spin axis motion
4. Spin Axis Azimuth Shows Small Enhancements, but could easily be interpreted as not particularly favoring any cardinal direction





Potest adhuc efficere:
“It could still work”